



U.S. Navy (Daniel G. Lavois)

REVOLUTIONS in Military Affairs

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In the early morning hours of the 15th of May, 1940, Prime Minister Churchill received an urgent telephone call from French Premier Reynaud. "We are beaten," Reynaud said in distressed English, "we have lost the battle." It had only been five days since the German army launched a broad offensive into France and the Low Countries. "Surely it can't have happened so soon," Churchill replied, incredulous at the rapidity of the defeat.¹ Six weeks later, France formally surrendered.

Blitzkrieg has been termed a revolution in military affairs or RMA—a fundamental change in the nature of warfare that the *Wehrmacht* used to inflict a rapid, stunning defeat on a qualitatively comparable, numerically superior force. Many factors contributed to the Allied collapse, but the essence of the German victory was the innovative operational exploitation of systems common to both sides: the tank, airplane, and radio. Speed, surprise, and deception,

Technological change may revolutionize warfare in the next century. Nations which can exploit emerging technologies through innovative operational doctrine and organizational adaptation may achieve significant gains in relative military effectiveness. In the past, America has had sufficient time to adapt in the midst of war to military revolutions that developed in peacetime. However the proliferation of technology may no longer afford the luxury of observing developments from the sidelines. The role of the military in developing concepts to exploit emerging technologies will be crucial in order to stay ahead of competitors. Junior officers in particular must be encouraged to think about the implications of the emerging revolution in military affairs.

combined with superior tactical and operational performance, gave the Germans a degree of relative operational superiority to which the Allies failed to adapt in time.

While nations have always pursued innovation to increase military effectiveness relative to potential adversaries, accelerating technological change, coupled with associated operational and organizational changes, has altered the character of war more profoundly in the last two centuries than ever before. The railroad, telegraph, steam-powered ironclad, and rifle caused dramatic increases in military effectiveness between the Napoleonic wars and the American Civil War. Similar changes accompanied the introduction of the machine gun, airplane, and submarine prior to World War I. By the outbreak of World War II the internal combustion engine, improved aircraft, radio, and radar made possible revolutionary leaps in long-range, highly mobile operations such as *Blitzkrieg* and carrier air strikes. The development of nuclear weapons at the end of World War II and their subsequent mating with ballistic missiles marked perhaps the most profound revolution in military affairs to date.

The stunning victory of the Armed Forces in the Gulf has stimulated increasing discussion of the possible emergence of a new RMA, which will again lead to major changes in the nature of conventional warfare. Such a revolution may be driven by the rapidly developing technologies of information processing and stealthy, long-range precision strike.

The following discussion has two purposes. The first is to present the question of an emerging revolution in military affairs and suggest why it may be significant. The second—and perhaps more important—is to encourage the readers of *Joint Force Quarterly*, particularly junior officers, to think and write about the explosive technological advances of our day and their implications for the way militaries will be organized and operate in the future.

What Are RMAs?

*Whereas we had available for immediate purposes one hundred and forty-nine first-class warships, we have now two, these two being the *Warrior* and*

*her sister *Ironside*. There is not now a ship in the English navy apart from these two that it would not be madness to trust to an engagement with that little [American] Monitor.*

—*The Times* (London), 1862²

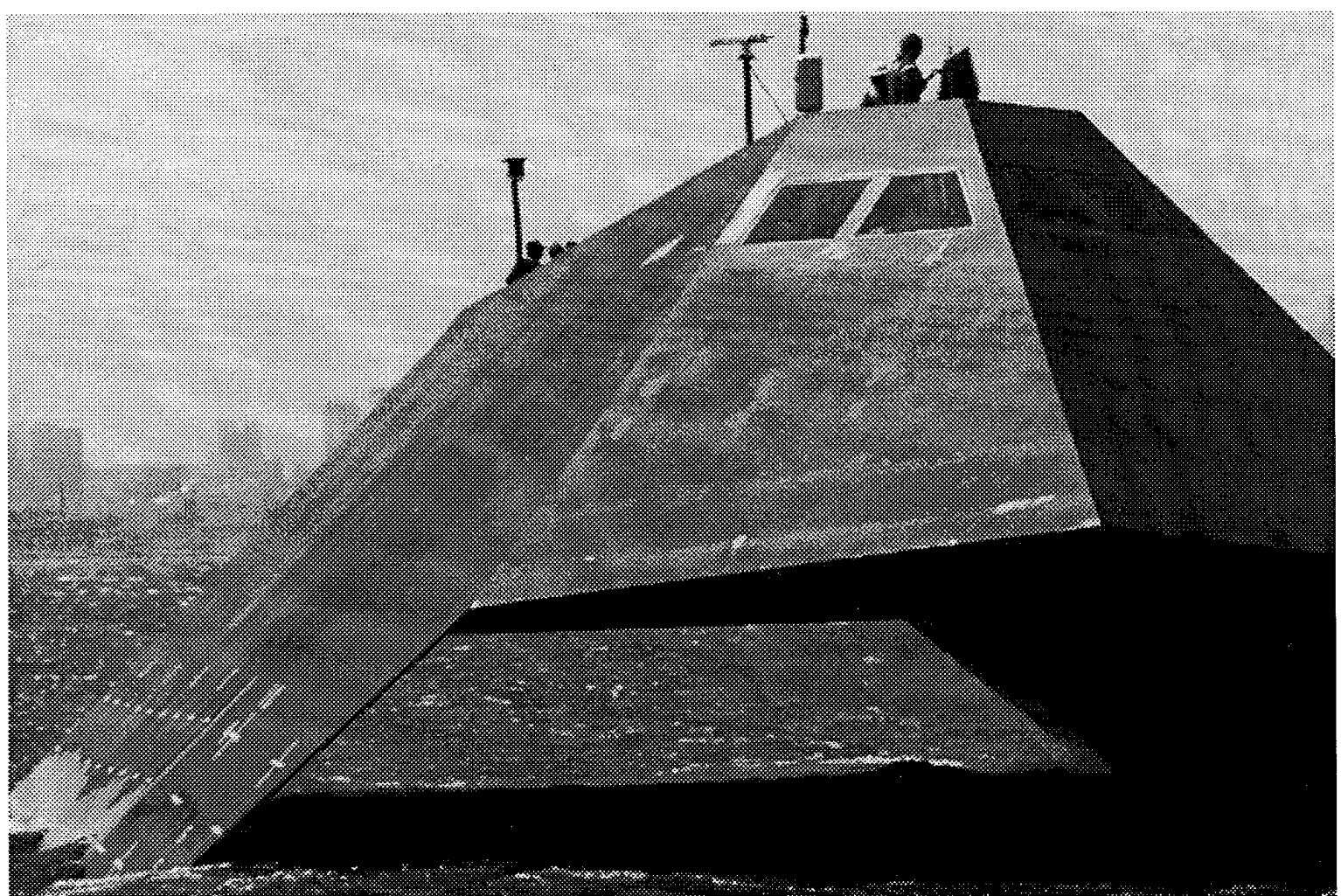
It is difficult to precisely and consistently define the term *revolution in military affairs*, though it is generally clear *ex post facto* when something of a revolutionary nature has occurred. An example of an RMA might be the universal change across warfare driven, for instance, by the development of the airplane or atomic bomb. Another sort might be the conversion from wooden sailing ships to steam-powered armored hulls in the latter half of the 19th century. Still another might be a consequence of major social or political upheaval, such as the French *levee en masse* which dramatically altered the scale of land warfare. One feature common to each, and perhaps the essence of an RMA, is not the rapidity of the change in military effectiveness relative to opponents, but rather the magnitude of the change compared with preexisting military capabilities.

Technological advances are usually a requisite for an RMA, but technology alone is not enough to achieve leaps in relative military effectiveness. As illustrated by *Blitzkrieg*, profound change only takes place when new concepts of operations incorporating new technologies are developed. Often this will require or result in new military organizations which reflect the new conditions.

History suggests three common preconditions to the full realization of an RMA:

▼ *Technological Development*—Since the Industrial Revolution there has been a stream of new technologies which intentionally or otherwise have had military applications. For example, development of a powerful, reliable internal combustion engine made possible the self-propelled vehicle and airplane. Mere invention, of course, is not enough; the new technologies must also be developed into practical military systems (or systems of systems as technologies become ever more complex). While the tank was introduced at Cambrai in 1917, it was years before it was reliable and robust enough to spearhead rapid ground advances.

▼ *Doctrinal (or Operational) Innovation*—To fully exploit the potential of new systems, operational concepts incorporating and integrating the new technologies must be developed into coherent doctrines. Military organizations must also train to use and interactively improve them. After the tank's introduction into combat, it took more



Experimental stealth ship *Sea Shadow* in San Francisco Bay.

U.S. Navy (George F. Champagne)

decades of doctrinal experimentation and development to produce *Blitzkrieg*.

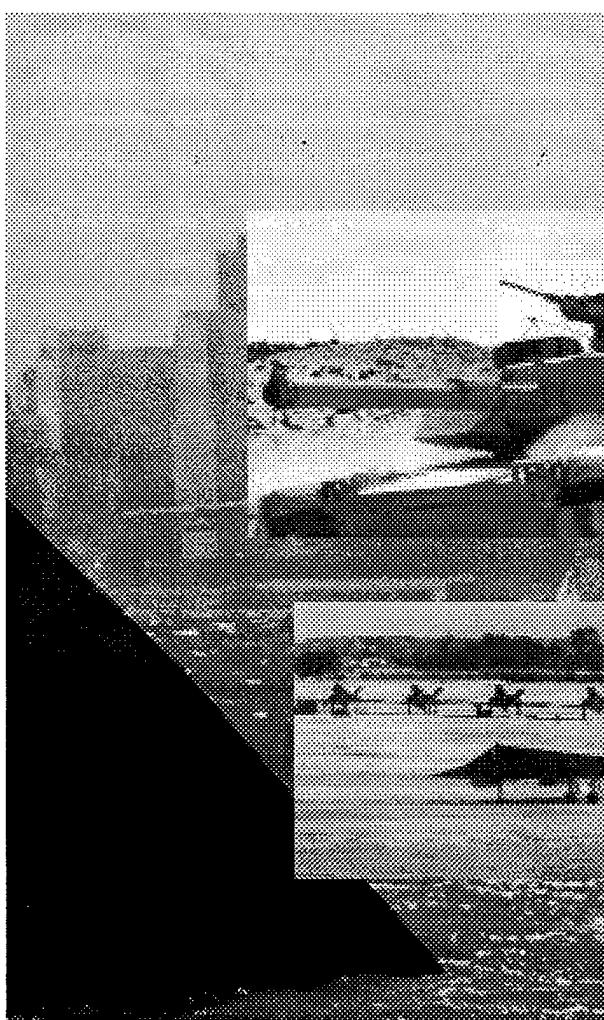
▼ *Organizational adaptation*—The most profound changes require significant bureaucratic acceptance and institutional change. The success of *Blitzkrieg* required not only the technology of the tank and a coherent doctrine of armored warfare, but also substantial organizational and even cultural changes which were reflected in the new combined arms operations centered on the German Panzer division.

It is the synergistic effect of these three preconditions that leads to an RMA. Indeed it is the increasing recognition of the importance of the doctrinal and organizational elements that has led to the term *revolution in military affairs* gaining currency over expressions such as *military-technical revolution* which implied that technology was the predominant factor.

Perhaps counter-intuitively, revolutionary changes do not generally occur during war. The fact of change may be most dramatically manifested in combat, but historically the most profound RMAs are peacetime phenomena (the atomic bomb may be the exception that proves the rule). For example, the transition from wooden sailing ships to steam-powered armored hulls in the last century was one of the more dramatic revolutions in military history, yet there were no major wars at sea in this period which underlined that fundamental change.

Militaries are driven to innovate during peacetime by the need to make more efficient use of shrinking resources, by reacting to major changes in the security environment, or by recognizing the possible implications of

prolonged peace provides the time and resources for experimentation



M1A1 Abrams in Saudi Arabia.

U.S. Army



F-117 Stealth fighters.

DOD

new inventions or techniques for their art. Prolonged peace provides the time and resources for experimentation. Equally important, this is the period of least risk if wrong choices are made. Consequently, long periods without major wars have generally resulted in the greatest changes.

Full exploitation of emerging technologies can span decades. The lengthy development of *Blitzkrieg* was noted earlier. Similarly, it took time to move from Kitty Hawk to strategic bombers and carrier task forces. The commercial analog is instructive; for instance, it took business years to fully exploit the telephone's potential or, more recently, exponential increases in computing power.

Is Another RMA Emerging?

In the early 1980s the Soviets noted that "the emergence of advanced non-nuclear

technologies was engendering a new *revolution* in military affairs."³ They were particularly interested in the "incorporation of information sciences into the military sphere" and in the idea of a "reconnaissance-strike complex."⁴ The events of the Gulf War convinced them of the validity of their hypothesis.⁵ Desert Storm indeed suggests that a new RMA is emerging.⁶ It may have provided a glimpse of a major transition to a different type of warfare heavily based on information processing and stealthy long-range precision strike weapons. What are some of the possible implications of this transition?

Information processing has always been part of warfare. In the future, however, it may be central to the outcome of battles and engagements. If so, establishing information dominance over one's adversary will become a major focus of the operational art. Information warfare is still an ill-defined term. However, it might encompass a range of concepts, including but not limited to:

- ▼ comprehensive intelligence regarding an enemy's military, political, economic, and cultural "targets" while denying the same to him
- ▼ disruption/manipulation of enemy C³I systems and defense of one's own
- ▼ space-based information usage and denial
- ▼ sensor-to-shooter data fusion
- ▼ flexible information/intelligence data bases
- ▼ use of simulations to support operational decisionmaking.

To the extent these notions have operational validity, they may also drive significant organizational changes.⁷

Stealthy long-range precision strike may become the dominant operational approach. By reducing the strike timeline from target sensor-to-shooter by orders of magnitude while increasing the effectiveness of weapons in terms of range, target discrimination, and lethality, such systems conceivably could provide conventional forces the ability to rapidly destroy an opponent's critical military targets at minimal cost and with little collateral damage. Some proponents even believe this approach extends to the destruction of an enemy's strategic centers of gravity.

There may well be other technologies, employed operationally in ways as yet unforeseen, that emerge to dominate future wars and preparations for them. Use of advanced simulations may greatly reduce cost and increase the speed of various military



Navy F/A-18C.

there is a substantial cost for failure to recognize revolutionary changes in warfare

activities. Commercial technologies such as microelectronics, telecommunications systems, space systems, nanotechnologies, robotics, and biogenetics, whose potential is only starting to be explored and which will be widely available, may also have enormous implications for military effectiveness. Moreover, these technologies and their operational employment may radically affect the whole gamut of military affairs, from combat operations and training to logistics and deployment practices to optimizing the responsiveness and flexibility of the industrial base.

In thinking about the proposition of an emerging RMA, it may be instructive to compare the present with the interwar years. By 1918, systems like planes, tanks, and radios were considered state of the art and represented quantum leaps over 1914. Yet the combat power represented by these same systems in 1940 was orders of magnitude greater than in 1918. The promise they held in 1918 only became decisive after two decades of



U.S. Navy (Jon Guzman)

Joint Combat Camera Center

USS Monsoon, a new class of coastal patrol ship, off the San Clemente Islands.

technical improvement, doctrinal development, and organizational adaptation. Could the *modern* systems such as stealth aircraft, cruise missiles, and smart weapons, the concepts of operations that employed them,

and the military organizations of the Gulf War be the "1918" equivalents in the context of a future "1940" war?

Why Do RMAs Matter?

RMAs matter principally for two reasons. First, being second best may lead to catastrophic loss in future wars. Since the only objective benchmark for determining the relative effectiveness of forces (that is, success in combat) is unavailable in long periods of peace, there is great potential for asymmetries in combat effectiveness between militaries, observable only when the next war has occurred. For example, the British and French experimented with tanks and aircraft in the interwar period, but their effectiveness was disastrously inferior to that of the *Wehrmacht*. However, few observers would have guessed at this reality in 1939. Obviously, there is a substantial cost for failure to recognize revolutionary changes in warfare before an opponent does.

Secondly, as equipment life cycles, especially for platforms, steadily grow to encompass decades (B-52s were designed in the late 1940's, carriers last 40-plus years), many of the principal weapons systems of 2025 will likely be designed and built in the next

few years. Since militaries are stuck with force structures they choose for long periods (though designs allowing for frequent system modifications ameliorate this to some extent), it is more crucial than ever to think now, in peacetime, about the impact of possibly revolutionary changes in the nature of war and about what will matter in winning wars in twenty or thirty years. Paradoxically, however, this may be more difficult even as it becomes more important.

Today, with the United States arguably the only superpower for the foreseeable future, one might ask why this issue is especially pressing. Replicating the U.S. force structure is clearly beyond the reach of all but a few other nations, even in the long term. This may not, however, be relevant. Even small- to medium-sized powers may be able to exploit specific technologies for significant military leverage in certain areas. Fifty years ago the Japanese fielded a highly capable military, technically advanced in selected aspects, which was more than a match for American forces during the early years of the Pacific war. Yet Japan's economy on the eve of World War II was maybe 15 percent the size of this Nation's. A more serious possibility is the emergence of a major competitor or coalition to seriously challenge the United States. Such a military peer might employ the same critical technologies which will serve as the basis of our Armed Forces and thus pose a direct threat to American vital interests.

The current rate of change suggests that *state of the art* in any technological context will be an extremely short-lived phenomenon, particularly with respect to the technologies that were key to the success of Desert Storm: space systems, telecommunications systems, computer architectures, global

information distribution networks, and navigation systems. Future revolutions will occur much more rapidly, offering far less time for adaptation to new methods of warfare. The growing imperative in the business world for rapid response to changing conditions in order to survive in an intensely competitive environment is surely instructive for military affairs. Corporations repeatedly have to make major changes in strategy to accommodate the full implications of technologies which have already existed many years.

In the military context, as with the tank, aircraft, radio, and other systems in 1918, the key technologies are out there and available for many nations to exploit. This places a premium on remaining at the forefront in the identification and implementation of the developments which will maintain, if not increase, relative military effectiveness well into the next century. Doing so can only come from encouragement of innovative thinking about the relevant questions.

Innovative Thinking

*Stationed at Camp Meade, Maryland just after World War I, Dwight Eisenhower and George Patton both began articles for military journals describing their experiments utilizing new doctrine for the employment of tanks. "Then I was called before the Chief of Infantry," Eisenhower later recalled. "I was told that my ideas were not only wrong but dangerous and that henceforth I would keep them to myself. Particularly, I was not to publish anything incompatible with solid infantry doctrine. If I did, I would be hauled before a court-martial."*⁸

Today's breathtaking technological achievements notwithstanding, developing the concepts of operations that incorporate new technologies and organizations to permit effective exploitation of new capabilities is even more critical than acquisition of the technologies themselves. Indeed, the most compelling lesson from the 1920s and 1930s is that some militaries were much better than others at developing and implementing successful concepts and also making the organizational changes to fully exploit new technologies.

Innovation is not necessarily or even primarily a function of budget. Many of the interwar innovations came at a time of low budgets and small forces. *Blitzkrieg* was developed while Germany was tightly restricted by the Versailles Treaty. American carrier naval aviation developed under a

GENERAL HEINZ GUEDERIAN **(1888-1954)**

Between 1914 and 1918 [Guderian] served mainly with the staff on the Western Front. In 1922 his task was to help develop the mechanization of the German army: by 1929 he had become convinced that tanks in all-arms, armoured (Panzer) divisions would in the future dominate land warfare. With Hitler's support, but obstructed by traditionalists, he promoted the creation of the German armoured forces which spearheaded the invasion of Poland in 1939.

— From *The Penguin Encyclopedia of Modern Warfare*
by Kenneth Macksey and William Woodhouse

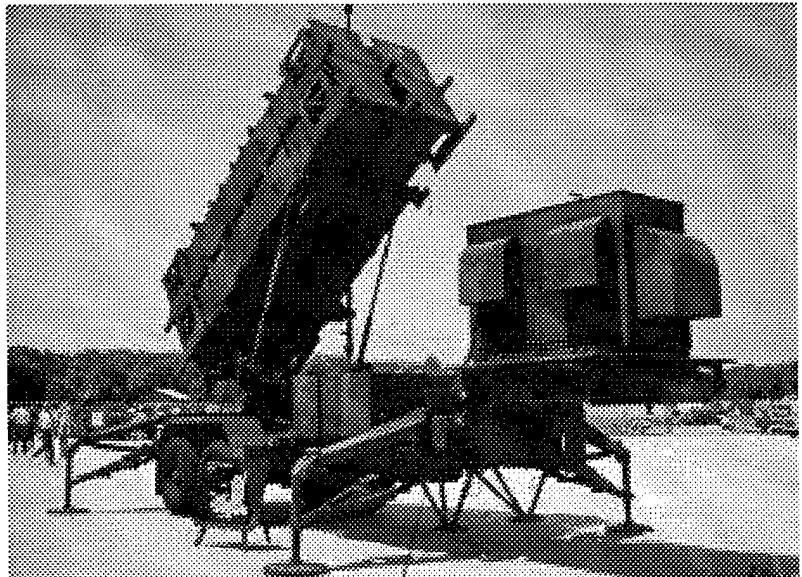


strict arms control regime in a fiscally constrained environment. The amphibious doctrine of the Marine Corps—which J.F.C. Fuller characterized as probably “the most far reaching tactical innovation of the war”—originates in the conceptual work of Major Earl H. Ellis in 1920 under the visionary tutelage of the Marine Commandant, Major General John A. Lejeune.

Why some innovations succeed and others fail, and why some militaries innovate rapidly while others languish, are matters for debate.⁹ History provides no clear guidance on overcoming institutional resistance to change and no final explanations of the relative roles of civilians, military mavericks, or visionaries. However, in one form or another, the military role in implementing innovative ideas is crucial. As one observer noted, “many important wartime technical innovations such as the tank, proximity fuse, and microwave radar, and organizational innovations such as new doctrines for submarine warfare and strategic targeting functions for American bombers, were pursued at the initiative of military officers or with their vigorous support.”¹⁰

What may be key to “winning the innovation battle” is a professional military climate which fosters thinking in unconstrained fashion about future war. This is in part a function of having leaders on the order of a Lejeune who will encourage innovation and—subject to reality checks—actually test and implement innovative ideas to maintain a preeminent military position.

Patriot missile system.



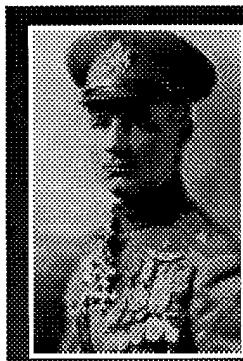
The other critical requirement is the ability and willingness of relatively junior officers who are now out in the field and fleet to think about the future. As younger people more recently out of school, they are likely to be in closer touch with new and emerging technologies which have potential military application. As operators, they are aware of the operational and organizational problems that they must deal with daily and hence are prime clients for possible solutions. Finally, they will also be the senior leaders who must win the wars twenty to thirty years from now.

Unfortunately, these same officers have published little to date in professional journals on the idea of an RMA, nor have RMAs been a focus of study at the service colleges.¹¹ There may be several reasons for this. Arguably the present force drawdowns put such a premium on preserving what exists that discussion of concepts which might threaten current programs is effectively stifled. Then organizations that have had recent success, as has the U.S. Armed Forces, probably feel less impetus for institutional change than if they had been less successful. And lastly, countries have historically not had good records of military innovation in periods such as the present when they cannot envision a well-defined military problem as the focus of planning and acquisition.

The failure of military officers to think about potentially crucial ideas such as an emerging RMA can carry with it the seeds of defeat, not least because the absence of a significant military contribution to the discussion of future wars will result in the subject being restricted to academics and think tanks. Although the latter have important ideas to bring to the table, inherently they can neither be as intimately familiar with military problems as professional officers nor as effective in implementing innovation from within the services.

Journals such as *JFQ* should play an important role in giving exposure to new ideas. Military officers, especially junior ones, should contribute views on emerging RMAs, or at least evaluate the implications of the stunning changes occurring today. As a starting point, the authors suggest the following broad questions:

▼ How will the emerging RMA change the nature of warfare in the next several decades?



NOTES

¹ Winston S. Churchill, *Their Finest Hour* (Boston: Houghton Mifflin, 1949), p. 2.

² Quoted in John Taylor Wood, "The First Fight of Iron-Clads," in *Battles and Leaders of the Civil War* (New York: Thomas Yoseloff, 1956), p. 692.

³ Mary C. Fitzgerald, "The Soviet Image of Future War: Through the Prism of the Gulf War," *Comparative Strategies*, vol. 10, no. 4 (October-December 1991), p. 393.

⁴ Ibid., p. 398.

⁵ Mary C. Fitzgerald, "The Soviet Military and the New Air War in the Persian Gulf," *Airpower Journal*, vol. 5., no. 4 (Winter 1991), p. 64.

⁶ The emerging nature of RMAs is the subject of an unpublished manuscript by Andrew F. Krepinevich, Jr., entitled "The Military Revolution."

⁷ A cogent proposal for consolidating information management recently appeared in these pages: see Martin C. Libicki and James A. Hazlett, "Do We Need an Information Corps?", *Joint Force Quarterly*, no. 2 (Autumn 1993), pp. 88-97.

⁸ Dwight D. Eisenhower, *At Ease: Stories I Tell to Friends* (New York: Doubleday, 1967), p. 173.

⁹ See for example Stephen Peter Rosen, *Winning the Next War: Innovation and the Modern Military* (Ithaca, N.Y.: Cornell University Press, 1991); Barry Posen, *The Sources of Military Doctrine: France, Britain, and Germany Between the World Wars* (Ithaca, N.Y.: Cornell University Press, 1984); and James S. Corum, *The Roots of the Blitzkrieg: Hans von Seeckt and German Military Reform* (Lawrence, Kans.: University Press of Kansas, 1992).

¹⁰ Rosen, *Winning the Next War*, p. 255.

¹¹ Antulio J. Echevarria and John M. Shaw, "The New Military Revolution: Post-Industrial Change," *Parameters*, vol. 22, no. 4 (Winter 1992-93), pp. 1-10, and John W. Bodnar, "The Military Technical Revolution: From Hardware to Information," *Naval War College Review*, vol. 46, no. 3 (Summer 1993), pp. 7-21, appear to be the only articles on RMAs in professional military journals in 1993.

¹² Paul Bracken, "The Military After Next," *The Washington Quarterly*, vol. 16, no. 4 (Autumn 1993), pp. 157-74.

The *Joint Force Quarterly* ESSAY CONTEST ON Revolutions in Military Affairs

JFQ initiates an annual essay contest cosponsored by the Office of the Secretary of Defense (Net Assessment) and the National Defense University Foundation to encourage innovative thinking on Revolutions in Military Affairs and how the Armed Forces can best prepare to remain dominant as the nature of warfare changes. All essays will be considered for publication in *JFQ*.

The contest will be open to military officers and civilians from this country as well as abroad. Cash prizes of \$2,000, \$1,000, and \$500 will be awarded to the three top entrants. In addition, a prize of \$500 will be awarded for the best essay submitted by either an officer candidate or officer in the ranks of major/lieutenant commander or below (and equivalent grades). All winners will also receive a selection of books dealing with innovation.

Look for entry rules and other details in the next issue of *JFQ* (Summer 94).